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THE ASSOCIATION BETWEEN *MYTILUS CHILENSIS* HUPE (BIVALVIA, MYTILIDAE) AND *EDOTEA MAGELLANICA* CUNNINGHAM (ISOPODA, VALVIFERA) IN SOUTHERN CHILE[1]

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Abstract

The association between *Mytilus chilensis* and the isopod *Edotea magellanica* in two natural banks of *Mytilus chilensis* from the intertidal area of the Straits of Magellan (southern Chile) is described. This may be the first documentation of such an association between a bivalve mollusc and an isopod. In Gregorio and Santiago Bays, 18.3% and 7.6%, respectively, of the mussels investigated were occupied by isopods. The highest degree of isopod occupation was found in mussels between 30 mm and 45 mm in shell length. The regression lines for the relationship between shell length and dry-tissue weight of mussels with and without isopods showed that the isopods have no influence on the meat content of the mussels. *Edotea magellanica* is a non-obligatory commensal, nourished on food that is associated with the host's activity (formation of pseudofeces) but that is not part of the host's food. The life cycle of *Edotea magellanica* was schematically constructed using the available data. The complete life cycle of the isopod can take place inside the mantle cavity of the mussel, and in many cases two isopod generations were observed in one and the same mussel.

Introduction

Marine bivalve molluscs are well documented in the literature as hosts for symbionts. Excellent reviews on this topic have been presented by Galtsoff (1964), Cheng (1967), and Sindermann (1970). No literature available to the authors, however, reported a commensalistic/parasitic association between bivalve molluscs and an isopod.

This paper describes such an association between *Mytilus chilensis* Hupé and the isopod *Edotea magellanica* Cunningham (Valvifera, Idotheidae). This isopod was first described in 1871, but never recorded as living within the mantle cavity of bivalve molluscs. The only hint of such an association is in Schultz (1969, p. 19), Schultz assumed that isopods are perhaps also parasitic on large molluscs such as clams.

In the intertidal area of the Straits of Magellan (southern Chile), numerous natural banks of *Mytilus chilensis* exist, and *E. magellanica* is found in comparatively high densities inside the mantle cavity of this mussel. We investigated two of these natural banks to determine the amount of occupation and the kind of association between the two species.

Materials and Methods

In August 1978, specimens of *Mytilus chilensis* were collected from Gregorio Bay (52°37′ S, 70°08′ W) and Santiago Bay (52°31′ S, 69°51′ W), on the northern

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side of the Straits of Magellan. The samples, taken during low tide from natural banks, included specimens from the entire intertidal area. The mussels were transported without water and stored in a freezer in order to avoid loss of isopods from the mussels' mantle cavities.

After its shell length was determined, each mussel was carefully opened and the number and position of isopods recorded. Isopods from each mussel were kept in separate small glass tubes for further analysis of sex and length. The length of each isopod was measured using a binocular microscope with a calibrated ocular micrometer. The length of an isopod was defined as the distance between the frontal margin of the cephalon and the tip of the telson in stretched animals.

In addition, we determined the dry-tissue weight of each mussel (after 24 h at 100°C), to calculate regression lines representing the relationship between shell length and dry-tissue weight in mussels with and without isopods.

Results

Occupation of mussels by isopods

In Gregorio and Santiago Bays, 18.3% and 7.6%, respectively, of the mussels investigated were occupied by the isopod *Edotea magellanica* (Fig. 1). The size class distribution of *Mytilus chilensis* from the natural banks in Gregorio Bay and Santiago Bay and the number of mussels occupied by isopods in different mussel size classes are presented in Figure 1. The most numerous size class of mussels with isopods was 40–45 mm in Gregorio Bay, and 30–35 mm in Santiago Bay.

In Gregorio Bay, mussels smaller in shell length than 25 mm were not occupied by isopods. In Santiago Bay, among the 38 mussels found in the 20–25 mm class, only one mussel was occupied by isopods. The absence of isopods in small mussels may be explained by the isopod's relatively large size: up to 13.4 mm in length in the mantle cavity of *Mytilus chilensis*. In neither of the bays investigated were isopods found in mussels larger than 50 mm in shell length. However, few specimens of these large size classes exist, so that the complete absence of isopods in these mussels could not be verified with certainty.

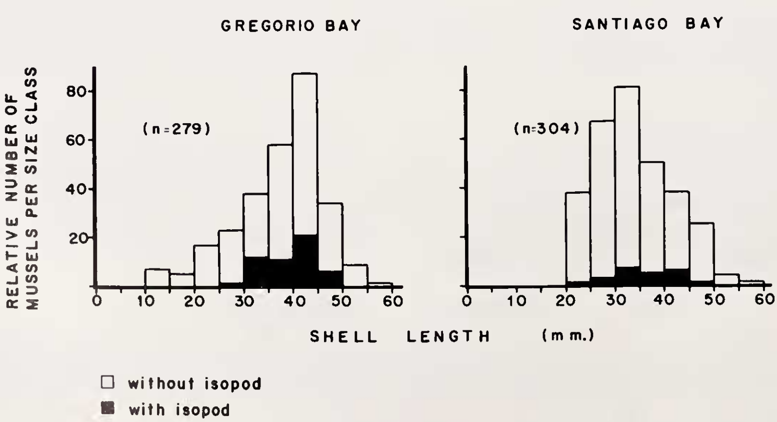

FIGURE 1. Size class distribution of *Mytilus chilensis* from the two different mussel banks investigated, and number of mussels occupied by isopods, by size classes.

Influence of the isopod on mussel meat content

To find whether isopod occupation influenced the meat content of *Mytilus chilensis*, the dry-tissue weights of the mussels with and without isopods were plotted against shell lengths (Fig. 2). Regression lines and covariance analysis (Sokal and Rohlf, 1969; Rohlf and Sokal, 1969) showed no such influence on meat content. Furthermore, from microscopic investigations, especially on the very delicate gills, it appears that specimens of *Edotea magellanica* do not damage the host's tissues.

Number, size, and sex-ratio analysis of isopods

Figures 3 and 4 show the number, size, and sex of each *Edotea magellanica* found in the mantle cavity of *Mytilus chilensis* from the two bays. An analysis of mussels occupied by isopods reveals that in Gregorio Bay and Santiago Bay, 29.4% and 65.2%, respectively, of the mussels contained only one isopod, a female. Two isopods, one female adult and one male adult, were found in 23.5% (Gregorio Bay) and 21.7% (Santiago Bay). Findings of two (7.8%) or three (2.0%) male adults (in addition to the female), which may function as progenitors alternately in one

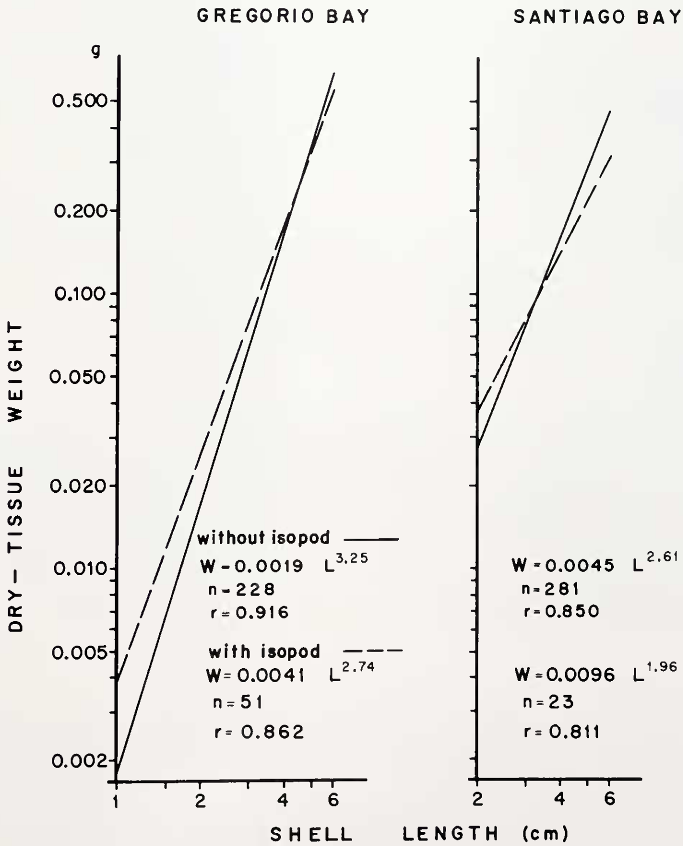

FIGURE 2. Correlation between shell length and dry-tissue weight in *Mytilus chilensis*, with and without isopods.

host (Fig. 3), were an exception in this isopod. In none of the mussels investigated was only one isopod, a male, found.

We found mussels occupied by up to 65 isopods. More than three males were found in 37.3% of the mussels occupied by isopods from Gregorio Bay and in 13.1% of those from Santiago Bay. However, these mussels always contained only one mature female, apparently the originator of all the generations in a given mussel. Specimens of a new isopod generation were differentiated in sex before leaving the host. The males reached their final length in the host where they were born (Figs. 3 and 4), while the females reached a maximum length of less than 5.5 mm before

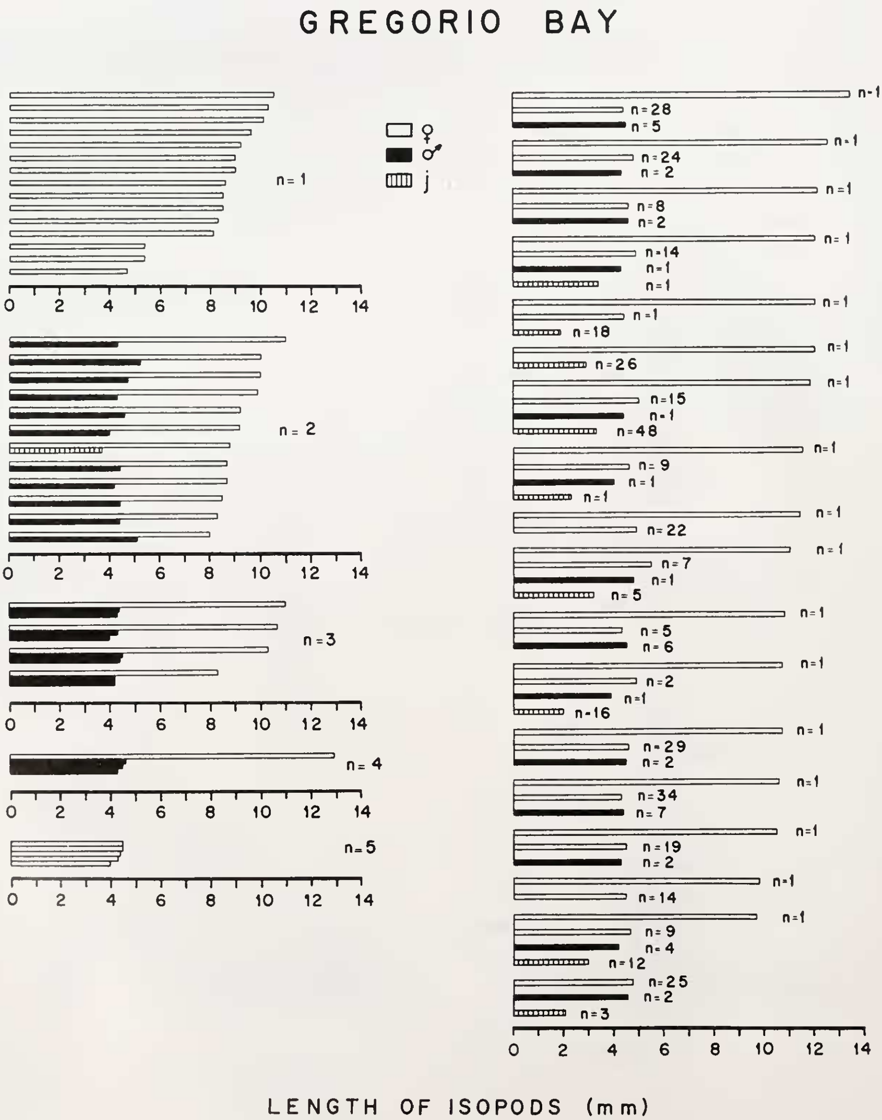

FIGURE 3. Number, size and sex of the isopods found in the mantle cavity of *Mytilus chilensis* in Gregorio Bay.

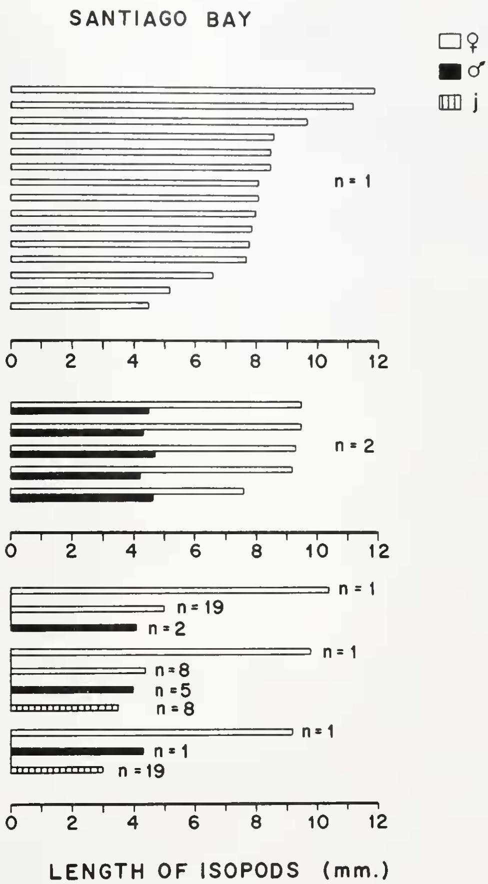

FIGURE 4. Number, size and sex of the isopods found in the mantle cavity of *Mytilus chilensis* in Santiago Bay.

leaving the host. Thus, in all cases where a mussel contained more than one female isopod, there were no females, the female progenitor excluded, with a length between 5.5 mm and 9.7 mm. The growth period that corresponds to this range of length seems to take place in newly occupied mussels (Figs. 3 and 4) or, if life is continued as a free-living isopod, in the corresponding environment. Furthermore, (Figs. 3, 4) the number of immature females always greatly exceeded that of males.

DISCUSSION

Presence of the isopod *E. magellanica* had no detectable negative effect on the meat content of *M. chilensis*. Therefore, we conclude that the isopods were not feeding on mussel food particles—that is, particles transported along the marginal food grooves of the gills and concentrated by the palps before entering the digestive tract. The isopod may be feeding on the pseudofeces, which are accumulated in the mantle cavity and which contain, entangled in mucus, energy-rich food particles.

Thus, *Edotea magellanica* should be considered a commensal, as defined by

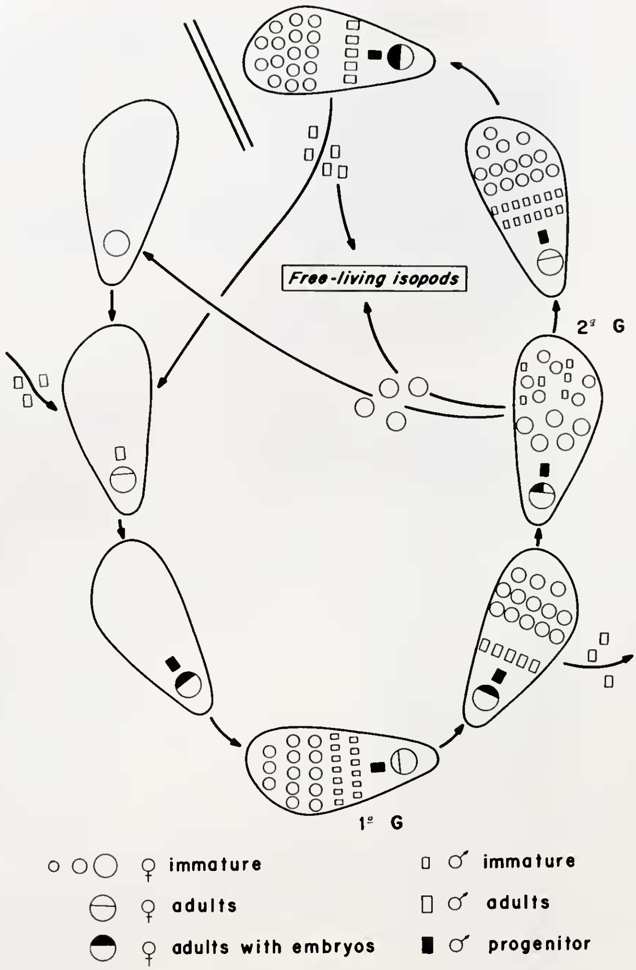

FIGURE 5. Schematic illustration of the life cycle of the isopod *Edotea magellanica* from the mantle cavity of *Mytilus chilensis*. Cycle from top left.

Cheng (1967, p. 6): "Commensalism describes that type of more or less intimate relationship during which the commensal generally derives physical shelter from the host, is nourished on foods that are associated but not a part of the host, and is not metabolically dependent on the host".

Edotea magellanica can also be found as a free-living isopod. As mentioned above, the species was found free-living when first described in 1871. On the northern side of the Straits of Magellan, this isopod was found burrowing in shell gravel and coarse sand under stones in the intertidal area. Thus, we consider *Edotea magellanica* a non-obligatory commensal. *Edotea magellanica*, as a commensal, is not restricted to a specific host. Specimens were found in other bivalves, such as *Mulinia sp.* Gray (estuary of Lingue River, 39° S, southern Chile; authors' unpublished observations) and *Aulacomya ater* (Molina) (information obtained by fishermen in Punta Arenas).

From the analysis of the data presented in Figures 3 and 4, the life cycle of

Edotea magellanica as non-obligatory commensal can be constructed as schematically illustrated in Figure 5.

From the large number of mussels (Gregorio Bay, 29.4%; Santiago Bay, 65.2%) occupied only by one isopod, and that a female, and the fact that no mussels were occupied by a lone male, we concluded that the mussel is occupied first by a female. The female isopod may then be joined by a male. A multiple "infection" of one mussel by more than one female adult seems to be avoided by a mechanism not yet understood, because in none of the mussels investigated did we find two or more adult (defined as >5.5 mm in length) females.

The new isopod generation develops in the marsupium and continues in the mantle cavity of the mussel when the embryos reach a length of about 1.9 mm (minimum length of isopods found free in the mantle cavity).

Since no mussel contained more than one female isopod longer than 5.5 mm, we conclude that all females of the new generation leave the mussel in which they were born.

The males may reach their final length in the mussel in which they were born, and leave their host before the emigration of the females of the same generation. This conclusion is supported by the fact that some mussels contain only young females of a generation under consideration, while a subsequent generation is growing up.

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